

MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL
(Formerly West Bengal University of Technology)
Syllabus of B. Sc in Biotechnology
(Effective from 2023-24 Academic Sessions)

Second Semester

Course Name: Basic microbiology

Mode: Offline

Credits: 5(3T+2P)

BMBT2101

Aim of the Course: The aim is to acquaint students with basics of microbiology

Course objective: To impart basic knowledge about the classification, growth and maintenance of microorganisms as well as the basic concept of sterilization along with a historical perspective. Staining basics and techniques and microbial metabolism were also to be studied.

Sl	Graduate attributes	Mapped modules
CO1	The student will get an introduction to the discipline of microbiology with an historical account, famous discoveries and different systems of classifications.	M1
CO2	The students will get a clear concept on stains and staining techniques to study bacterial morphology	M2
CO3	The student shall get a concept of Microbial growth and nutrition. They will be able to decide specific culture media, basic bacteriological techniques, growth patterns etc.	M3
CO4	The students will be able to know various mechanisms of genetic modifications in bacteria (Transformation, transduction, conjugation)	
CO5	The details about concepts of physical and chemical means of sterilizations and their effective mode of actions are the knowledges students will learn.	M4
CO6	The student are expected to be aware about the determination of sanitary quality of water and treatment methods of sewage water.	M5
CO7	The students will be able to comprehend knowledge regarding various fermented food products, food products, food spoilage and food borne diseases. Food preservation techniques and acquaintance with prebiotic foods will be an additional skill.	

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Learning Outcome/ Skills:

The candidates should demonstrate fundamental knowledge about history of microbiology, classification and for the candidate to be able to understand and solve problems related to sterilization process, the staining knowledge etc.

Knowledge and understanding should be demonstrated in the areas of metabolism, role of microorganisms On water and food after completion. Different growth/ culture media, techniques , identifications all these knowledge will be acquired on completion.

Module Number	Content	Total Hours	% of questions	Bloom Level (applicable)	Remarks, if any
THEORY					
M1	History of Microbiology, contribution of eminent scientists and systems of classifications	7	15	1,2	NA
M2	Basic principles of Stains and staining techniques	6	10	1,2,3,4	NA
M3	Culture techniques Microbial metabolisms, growth pattern, nutrition, maintenance and preservation of pure cultures	9	25	1,2,3,4	NA
M4	Basic concepts on Bacterial gene transfer:Transformation, Transduction, and conjugation	4	10	1,2	NA
M5	Concept of sterilization- physical and chemical methods asnd mode of action.	8	20	1,2,3	NA
M6	Water microbiology, Bacterial pathogen, microbiological quality of water	5	10	1, 2,3	NA
M7	Food microbiology: microbes associated with foods and food borne disease, food preservation, fermented foods and probiotics	6	10	1,2	
Total		45	100		

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Theory					
<u>Practical</u>		30			
	TOTAL	75			

Detailed Syllabus

Module 1:

History and scope of microbiology

Overview of history of Microbiology -

Biogenesis and abiogenesis, Contributions of Redi, Spallanzani, Needham, Pasteur, Tyndal, Joseph Lister, R. Koch [Germ Theory], Edward Jenner and A. Flemming [Penicillin], Scope of Microbiology.

Systems of classification- Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Classification of Microbes (Microbial Taxonomy) - Identifying characters for classification, General properties and principles of classification of microorganisms. Systematics of bacteria, Numerical taxonomy, General properties of Archae and Eubacteria.

(Total Hours: 7)

Module 2:

Stains and staining techniques –

Definition of auxochrome, chromophores, dyes, Classification of stains, Theories of staining, Mechanism of gram staining, acid fast staining, negative staining, capsule staining, flagella staining, endospore staining.

Total Hours: 6

Module 3:

Microbial growth and nutrition - Common nutrient requirements, nutritional types [Definition and examples], Types of culture media, Methods of isolation of pure culture; Cultivation, Maintenance and Preservation of pure cultures.

Growth curve, Generation time, Batch culture, synchronous and continuous culture, measurement of growth and factors influencing microbial growth. Classification of microbes on the basis of oxygen requirement.

Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways.

Bacterial gene transfer – Transformation, Transduction and conjugation.

Total Hours: 9

Module 4:

Bacterial recommendation

Overview of transformation, transduction and conjugation

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Total Hours: 4

Module 5:

Concept of Sterilization, Physical methods of sterilization - dry and moist heat, tyndallization , pasteurization, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation, ultrasonication. Chemical methods of sterilization - disinfectants, types and mode of action. Definition of MIC , sanitization, antisepsis and fumigation. Determination of Phenol coefficient of disinfectant.

Total Hours: 8

Module 6:

Water Microbiology: Bacterial pollutants of water, coliforms and non coliforms. Sewage composition and its disposal.

Total Hours: 5

Module 7:Food Microbiology:

Important microorganism in food Microbiology: Molds, Yeasts, bacteria. Major food born infections and intoxications, general principles and methods of food preservation, Fermented Foods (Yoghurt, cheese, Idli, Kinema), Probiotics and Prebiotics.

Total Hours: 6

PRACTICAL

Credit: 2

Total Hours: 30

BMBT2191

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Introduction, operation, precautions and use of common microbiology laboratory instruments: (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope) .
2. Preparation of different culture media and inoculation techniques - Nutrient agar, Nutrient broth, McConkey agar, EMB agar, Sabaraud's Chloramphenicol agar, YEPD agar, BG-11.
3. Sampling and enumeration of viable microorganisms in air, soil and water.
4. Isolation of pure cultures of bacteria by streaking, spreading, pour plate method .
5. Staining techniques- [simple staining, Gram's staining, acid fast staining, capsule staining, endospore staining , negative staining, fungal staining]
6. Observation of motility in bacteria using: Hanging drop method.
7. Microscopic measurements- micrometer (ocular and stage).

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Course Name: Plant and mammalian physiology

Mode: Offline

Credits: 5(3T+2P)

BMBT2102

Aim of the Course: The aim is to acquaint students with basics of plant and mammalian physiology

Course objective: To acquaint students with Concepts of basic physiology of plant and mammalian systems.

To impart knowledge about the basic physiological mechanisms of both plants and mammalian systems as well as overview of growth and development.

Basic Knowledges about Digestion and Respiration, circulation, Muscle physiology, Nervous and endocrine coordination etc were provided

Informations and knowledge about Plant water relations, carbon-nitrogen metabolism, growth and developments in plants- were discussed .

Students will learn basic physiology in both plant and mammalian systems

Sl	Graduate attributes	Mapped modules
CO1	The student will get an introduction to the discipline of Digestion and Respiration in mammalian system	M1
CO2	The students will get a clear concept on Respiration in plants	M2
CO3	The student shall get a concept of Circulation In mammalian systems.	M3
CO4	The details about concepts of Plant water relations-diffusion , osmosis , as well as nutrient uptakes are the knowledges students will learn.	M4
CO5	The student shall master the Muscle physiology and osmoregulation basics.	M5
CO6	The knowledge about Carbon and nitrogen metabolism in plants will be attained by students on completion . Different problems associated with photosynthesis, photphosphorylation , photorespiration and nitrogen fixation etc will be mastered by the students.	M6
CO7	The knowledge about Nervous and endocrine coordination will be attained after completion.	M7

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CO8	A thorough knowledge about Growth and development-Germination, dormancy in plants will be attained.	M8
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Learning Outcome/ Skills:

The candidates should demonstrate fundamental knowledge about history of microbiology , classification and for the candidate to be able to understand and solve problems related to sterilization process, the staining knowledge etc.

Knowledge and understanding should be demonstrated in the areas of metabolism, water and food microbiology after completion .

Module Number	Content	Total Hours	% of questions	Bloom Level (applicable)	Remarks, if any
THEORY					
M1	Digestion and Respiration in mammalian system -their importances , Transport of O₂ and CO₂, Oxygen dissociation curve	5	10	1,2	NA
M2	Respiration in plants, regulation and its anabolic role, Conversion of Pyruvic acid to Acetyl CoA, TCA-cycle and its amphibolic role, Oxidative pentose phosphate pathway and its significance	4	10		
M3	Circulation- Mechanism of coagulation of blood. Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat.	5	15	1,2,3	NA
M4	Plant water relations-diffusion , osmosis , nutrient uptake	5	10		
M5	Muscle physiology and osmoregulation , isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction. Excretion: modes of excretion, Ornithine cycle	6	20		

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M6	Carbon and nitrogen metabolism, photphosphorylation, cycle, CAM plants, photorespiration etc.	7	10	1,2,3	NA
M7	Nervous and endocrine coordination , structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitter Mechanism of action of hormones (insulin and steroids) Different endocrine glands–	7	15	1,2	NA
M8	Growth and development- Germination, dormancy	6	10	2,3	NA
Total Theory		45	100		
<u>Practical</u>		30			
	TOTAL	75			

Detailed Syllabus

Module 1:

Digestion and Respiration in mammalian system

Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids.
 Respiration: Exchange of gases, Transport of O₂ and CO₂, Oxygen dissociation curve, Chloride shift.

(Total Hours: 5)

Module 2:

Respiration in plants

Respiration: EMP pathway, regulation and its anabolic role, Conversion of Pyruvic acid to Acetyl CoA, TCA-cycle and its amphibolic role, Oxidative pentose phosphate pathway and its significance, Mitochondrial electron transport system, Oxidation of cytosolic NADH+H⁺ , Stoichiometry of glucose oxidation (aerobic).

(Total Hours: 4)

Module 3:

Circulation

Circulation -Composition of blood, Plasma proteins & their role, blood cells, Haemopoiesis, Mechanism of coagulation of blood. Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat.

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Total Hours: 5

Module 4:

Plant water relations and micro & macro nutrients ,
diffusion, osmosis, plasmolysis, imbibition, guttation, transpiration, stomata & their mechanism of opening & closing.

Micro & macro nutrients: criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients, mechanism of uptake of nutrients, mechanism of food transport

Total Hours: 5

Module 5:

Muscle physiology and osmoregulation

- Structure of cardiac, smooth & skeletal muscle, threshold stimulus, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction. Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation.

Total Hours: 6

Module 6:

Carbon and nitrogen metabolism

Photosynthesis- Photosynthesis pigments, concept of two photo systems, photophosphorylation, calvin cycle, CAM plants, photorespiration, compensation point Nitrogen metabolism- inorganic & molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants.

Total Hours: 7

Module 7:

Nervous and endocrine coordination

Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitter Mechanism of action of hormones (insulin and steroids)
Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.

Total Hours: 7

Module 8:

Growth and development

Growth and development: Definitions, phases of growth, growth curve, growth hormones (auxins, gibberlins, cytokinins, abscisic acid, ethylene) Physiological role and mode of action, seed dormancy and seed germination, concept of photoperiodism and vernalization

Total Hours: 6

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PRACTICAL

Credit: 2

Total Hours: 30

BMBT2191

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Finding the coagulation time of blood
2. Determination of blood groups
3. Counting of mammalian RBCs
4. Determination of Haemoglobin
5. Preparation of stained mounts of anatomy of monocot and dicot root and stem.
6. Separation of photosynthetic pigments by paper chromatography.
7. Demonstration of aerobic respiration and photosynthesis